

ABSTRACTS OF PAPERS

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ABSTRACTS

EFFECT OF PHENAMIPHOS, ALDICARB, STEAM STERILIZATION AND SOIL PASTEURIZATION WITH AERATED STEAM ON CABBAGE YIELD. G. S. Abawi and W. F. Mai, Depts. of Plant Pathology, Cornell University, Geneva and Ithaca, NY.

The effects of phenamiphos, aldicarb, steam-sterilization, and soil pasteurization with aerated steam for 30 min at 50, 60, 70 and 80 C on cabbage yield were evaluated in microplots using cabbage field soil with no detectable level of *H. schachtii*. All treatments, except pasteurization at 50 C, resulted in significant increase in marketable yield. A significant increase in cabbage yield also occurred when phenamiphos was added to soil previously pasteurized at 50 C, but not at 60, 70, 80 C or steam-sterilized. However, yield from the latter treatments with phenamiphos was always higher. Generally, differences between treatments were evident as early as 3 to 4 weeks after planting. Preliminary isolation data made from seedlings revealed no pathogens and there was little difference among the treatments in root discoloration and weight. Although insecticides were applied, cabbage seedlings growing in soils treated with phenamiphos or aldicarb had lower ratings of flea beetle damage.

MEASUREMENT AND CHARACTERIZATION OF VERTICAL DISTRIBUTION OF NEMATODES IN SOIL. J. R. Babu and T. A. Chen, Dept. of Plant Pathology, Rutgers University, New Brunswick, NJ 08903.

Two measures, "mean depth" and "depth deviation," have been adapted (M. B. Usher, 1970. *Pedobiologia* 10:224-236) to study the vertical distributions of nematodes in an uncultivated and mature habitat consisting of a plot of established turfgrass. The habitat contained seven genera of plant parasitic nematodes, *Macroposthonia* forming nearly 85% of the population. These measures treat the sampled profile as a continuum and express the distributions as indices that determine whether the nematodes are located deeper in the profile or closer to the surface. These indices have been used to study the relationship between vertical distribution of nematodes and temperature and moisture of turfgrass. The uniformity of population distribution in the soil profile is positively correlated to moisture levels, and negatively to temperature. The use of such measures in studying vertical distributions in relation to seasonal variation in populations is discussed.

A SOIL-FREE MODEL FOR EVALUATING NON-FUMIGANT NEMATOCIDES. F. A. Preiser, J. R. Babu, and A. A. Haidri. Merck & Co., Inc. P.O. Box 2000, Rahway, New Jersey 07065

Nematicidal properties of chemicals have been evaluated in a model consisting of cucumber seedlings growing in the diSpo[®] growth-pouch apparatus and inoculated with *Meloidogyne* larvae. Responses were quantified as numbers of galls produced. A linear least squares relationship between the square root-transformed gall counts and log of corresponding inoculum levels was constructed. The slopes of these lines among different experiments were similar. Doses of nematicides needed to obtain a 50% reduction in gall counts as compared to a control (ED₅₀), and the corresponding confidence intervals were calculated.

EFFECT OF THIABENDAZOLE AND PENTACHLORONITROBENZENE ON FOUR SOIL-BORNE FUNGI PATHOGENIC TO POTATO. B. Bandy and S. S. Leach, Dept. of Botany and Plant Path., Univ. of Maine and USDA-SEA/AR, Orono, Maine.

Isolates of four soil-borne fungal pathogens of potatoes, *Fusarium roseum* 'Sambucinum', *Helminthosporium solani*, *Rhizoctonia solani*, and *Verticillium albo-atrum*, were grown on fungicide amended agar media to determine what concentrations of thiabendazole or pentachloronitrobenzene (PCNB) would inhibit radial growth of the fungi. All four of the fungi were tested on thiabendazole amended media, and two species, *R. solani* and *V. albo-atrum*, were also tested on PCNB amended agar. PCNB, at 50,000 and 75,000 ppm almost completely inhibited the growth of *R. solani*, and significantly reduced that of *V. albo-atrum*. Thiabendazole completely inhibited the radial growth of *R. solani*, *F. roseum* 'Sambucinum', *H. solani* and *V. albo-atrum* at 7.0, 3.5, 1.75 and 1.75 ppm, respectively. The similar response of all four species to 1.75-7.0 ppm thiabendazole suggests the possibility of using a single seed tuber treatment containing this fungicide to control the seed-borne inoculum of the pathogens.

FUNGI ASSOCIATED WITH CALYX-END ROT OF APPLES IN MASSACHUSETTS. Ted R. Bardinelli, Charles W. McCarthy, and William J. Manning, Department of Plant Pathology, University of Massachusetts, Amherst, MA 01003.

Calyx-end rot of apples was unusually prevalent in 1980. Many infected fruits dropped prematurely which resulted in up to 10% yield losses in commercial orchards. Milton was the most susceptible cultivar, having up to 30% infection, in some cases. MacIntosh was very susceptible with fruit infection generally twice that of Red Delicious. To determine the cause of the problem, isolations were made from 200 fruit, selected for early and late symptom expression. *Sclerotinia sclerotiorum* accounted for 98% of the fungi isolated from fruit with early symptoms. The other 2% were isolates of *Alternaria* and *Botrytis*. Incidence of *Sclerotinia* from fruit with late symptoms dropped to 36% and these were often mixed with other fungi. *Alternaria* and *Botrytis* accounted for most of the fungi isolated. Stage of symptom development is therefore an important factor in determining the causal agent of calyx-end rot.

A FUNGICIDE RESIDUE BIOASSAY TECHNIQUE AS A COMPONENT OF APPLE DISEASE MANAGEMENT. Ted R. Bardinelli, Charles W. McCarthy, and William J. Manning, Department of Plant Pathology, University of Massachusetts, Amherst, MA. 01003.

A fungicide residue bioassay technique was evaluated under field conditions for effectiveness as a predictive tool in management of primary apple scab. Plates of potato dextrose agar (PDA) were seeded with 5×10^5 spores of either *Glomerella cingulata* or *Saccharomyces cerevisiae*. Leaves were removed in sequence from terminals. One 6mm disc from each leaf was plated in sequence on seeded PDA and incubated at 22 c for 18 hours. The radii of resulting spore germination inhibition zones were averaged and compared to known dose/response curves for captan and thiram residues. Spray applications were made only when residues were below threshold levels necessary for primary scab management. Using this technique, it was possible to reduce the number of spray applications from 7 to 5 and dosage equivalents from 6.5 to 3.5.

SURVIVAL OF A MARKER STRAIN OF PSEUDOMONAS SYRINGAE PV. PAPULANS IN APPLE LEAF SCARS. Karen Bedford, Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada, N1G 2W1.

The ability of the bacterium responsible for the Blister Spot disease of Mutsu apple to overwinter in leaf scars was studied. A marker strain resistant to nalidixic acid and rifampicin was used to inoculate leaf scars in November. Subsequently, inoculated leaf scars and associated axillary buds were sampled and assayed on three occasions over the winter. Total fluorescent and antibiotic resistant bacterial populations were enumerated. The marker strain was recovered from a significant number of leaf scars and buds on each

occasion. A dramatic drop in total populations occurred from November to January. Populations of the marker strain were detectable in the March sample, and thus implicate leaf scars and buds as possible sources of primary inoculum.

SELECTIVE PRUNING OF *PINUS RESINOSA* RESULTS IN REDUCED RATES OF INOCULUM PRODUCTION AND INFECTION BY *GREMMENIELLA ABIETINA*. D. R. Bergdahl and T. M. Ward, Dept. of Forestry, University of Vermont, Burlington, Vermont 05405.

Scleroderris canker caused by *Gremmeniella abietina* is a serious fungus disease of conifers, especially hard pines. This fungus usually attacks the lower-most branches of a tree first and then proceeds to canker and kill branches throughout the upper crown. Pruning all branches from the lower third of the crown of red pine resulted in reduced rates of infection for seedlings, branches and large trees, as compared to unpruned plots. In pruned plots the overall inoculum densities were also reduced as well as the duration of conidiospore production. Pruning wounds did not serve as infection courts even when pruning was done during the peak period of conidiospore production. Pruned branches did not have to be removed from the plantation to achieve these results.

THE ENLARGEMENT OF CYTOSPORA CANKER OF HYBRID POPLAR AND ASSOCIATED BARK WATER RELATIONS. Alan R. Biggs and D. D. Davis, The Pennsylvania State University, Department of Plant Pathology, University Park, Pennsylvania 16802.

Stem sections of hybrid poplar (*P. trichocarpa* X *P. maximowizii* NE 388) 20 cm long and 1 cm dia were inserted into pots of 1:1 peat:perlite mix and placed outdoors. Beginning the day after planting and at weekly intervals thereafter, a randomly selected set of 10 plants was preconditioned for 18 hr in a growth chamber (22 C, 75% RH, 33 Klux for 16 hr/day) and inoculated with agar plugs containing mycelium of *Cytospora chrysosperma* placed in 7 mm dia wounds created by the removal of bark tissue with a cork borer. The excised bark tissue was immediately subjected to water potential measurements and control wounds were 2.5 cm below and opposite the first. The second bark disc was used to determine gravimetrically bark relative turgidity. Canker size measured after 1 wk was positively correlated ($r=0.73$) with bark relative turgidity and negatively correlated ($r=-0.74$) with bark water potential ($p=0.0001$).

SCANNING ELECTRON MICROSCOPE STUDY OF APOTHECIAL MATURATION IN *NAEMACYCLUS MINOR*. S.N. Braen and W. Merrill, 210 Buckhout Lab University Park, PA 16802

The 1978 needles of *Pinus sylvestris*, infected by *Naemacyclus minor* in spring 1979 and cast in winter 1979-80, were collected weekly in spring 1980, fixed in glutaraldehyde in 0.15 M cacodylate buffer, dehydrated in an ethyl alcohol series, critically point dried in liquid CO₂, sputtered with gold, and examined at 10 KV with a scanning electron microscope. In mid March, only paraphyses could be seen in hymenia viewed from above. Through late March and early April asci elongated until they protruded above the paraphyses and began to develop swollen ends. A few asci ejected spores following rain as evidenced by open opercula. Through April more asci elongated and swelled. In late April, most asci ejected spores following a rain; thereafter the hymenia consisted only of paraphyses. Thus several weeks of warm weather appear necessary for maturation of apothecia formed the previous fall, thereby accounting for the previously observed major infection period in late April and early May.

EVIDENCE FOR RESISTANCE TO METALAXYL IN ISOLATES OF *PERONOSPORA TABACINA*. R. I. Bruck, G. V. Gooding, Jr. and C. E. Main. Dept. Plant Pathology, N. C. State University, Raleigh NC 27650.

Isolates of tobacco blue mold (*Peronospora tabacina* Adam) were collected from the Burley tobacco growing region of western North Carolina between 7/23/80 and 8/8/80. Collection areas were reported treated (2 qt/acre, preplant soil incorporation) with metalaxyl (Ridomil 2EC, CCA-48988, N-(2-6-dimethylphenyl)-N-(methoxyacetyl) alanine methyl ester). Conidia were removed by swirling excised lesions in a test tube in 6 ml of sterile distilled water. Approximately 2 ml of conidial suspension (2000 spores/ml) were atomized onto 4-leaf stage potted plants treated 24 hrs prior to inoculation with metalaxyl (ranging from 0 to 200 ug(a.i.)/ml). Three out of 14 isolates tested were able to form lesions, sporulate and reinfect plants when recovered from hosts treated with up to 100 ug(a.i.)/ml. No infection occurred in the other 11 isolates on plants treated with as little as 25 ug(a.i.)/ml. These data suggest that metalaxyl resistant isolates may exist in nature.

RESISTANCE TO ACYLALANINE-TYPE FUNGICIDES IN *PERONOSPORALES*. G.C.A. Bruin and L.V. Edgington, Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada. N1G 2W1

Several species of *Phytophthora* and *Pythium* lost their sensitivity to metalaxyl during 12 transfers on V8 agar amended with sublethal concentrations of metalaxyl, but no adaptation occurred when *Phytophthora infestans* or *Peronospora parasitica* were exposed to sublethal concentrations of metalaxyl in potato tuber tissue and cabbage seedlings, respectively. *P. infestans* was resistant in vitro but did not grow on potato tuber tissue treated with 0.015 µg metalaxyl per g tissue. Irradiation of zoospores of *Phytophthora capsici* and mycelium of *Pythium ultimum* resulted in strains with a stable resistance. Resistance to metalaxyl conferred cross resistance to the related fungicides furalaxyl, RE20615, RE26745, RE26940 and Galben. Large differences in metalaxyl sensitivity between mono-zoospore cultures indicate that nuclei with different 'sensitivity' to metalaxyl may exist together in the coenocytic mycelium.

ROOT STARCH CONTENT OF DECLINING URBAN MAPLE TREES. J. E. Carroll and T. A. Tattar, Shade Tree Laboratory, Dept. of Plant Pathology, Univ. of Massachusetts, Amherst, MA 01003 and P. M. Wargo, Forest Insect-Disease Lab, USDA Forest Service, Hamden, CT 06514.

Starch content of roots can indicate stress caused by insect defoliation to deciduous trees. Sugar maple trees (*Acer saccharum* Marsh.) growing in Amherst and in West Springfield, Mass. are being studied to determine the relationship between root starch content and decline symptoms. Three root samples per tree are collected in the fall after leaf drop. Root starch content is determined by a visual method using an iodine stain (Wargo, 1975, USDA For. Serv. Res. Pap. NE-313). Each root sample is rated for starch content as high, medium, low or depleted. Most trees in severe crown decline have low or depleted starch while trees with healthy appearing crowns have high starch reserves. However, trees with high starch and poor crowns do occur, as well as trees with low starch reserves and healthy crowns. Determining the starch content of roots could become a useful diagnostic tool in the evaluation of tree health.

DETECTION OF TOBACCO RINGSPOT VIRUS AND TOBACCO MOSAIC VIRUS IN *FRAXINUS* UTILIZING LATEX PARTICLE AGGLUTINATION. J. D. Castello and M. T. O'Shea, Department of Environmental and Forest Biology, S.U.N.Y. College of Environmental Science and Forestry, Syracuse, N.Y. 13210

Both tobacco ringspot virus and tobacco mosaic virus have been detected in green ash (*Fraxinus pennsylvanica*) and white ash (*F. americana*) using the latex particle agglutination technique. These viruses have not previously been reported from green ash. The viruses have been detected singly, and in combination. In white ash leaf samples collected in late summer from Lafayette, N.Y., both viruses were detected. In this instance, virus presence was associated with premature fall coloration, chlorotic mottling, small foliage, and brilliant red and green ringspots on the apical leaves. In most cases however, trees were sampled early in the growing season and were asymptomatic.

FREQUENCY AND DISTRIBUTION OF TOBACCO RINGSPOT VIRUS AND TOBACCO MOSAIC VIRUS IN *FRAXINUS* IN NEW YORK STATE. J. D. Castello and M. T. O'Shea, Department of Environmental and Forest Biology, S.U.N.Y. College of Environmental Science and Forestry, Syracuse, N.Y. 13210

Five hundred and five ash trees were indexed for tobacco ringspot virus and tobacco mosaic virus by latex particle agglutination. Leaf samples were collected in May from both white and green ash. Sample locations included Rochester, Syracuse and Poughkeepsie, N.Y., and rural locations throughout New York State. Thirty-one trees (6%) indexed positive for one or both viruses. Over 50% of the infected trees were located in the lower Hudson Valley; an area where white ash dieback is most severe. Viruses were detected more often from rural than urban locations, and from central and southern New York than western and northern New York. The significance of these viruses in the etiology of white ash dieback needs to be investigated.

AMINO ACIDS REQUIREMENT FOR THE *IN VITRO* GROWTH OF *SPIROPLASMA CITRI*. C. J. Chang and T. A. Chen, Plant Pathology Department, Cook College-Rutgers University, New Brunswick, NJ 08903.

A PPLO broth-free medium containing inorganic salts, amino acids, nucleosides, nucleotide, carbohydrates, coenzymes, and horse serum was developed to investigate the amino acid requirements for the *in vitro* cultivation of *S. citri*. Amino acids were grouped into ten combinations based on their structural differences, roles in biosynthesis of new sugars, and the essentiality for higher animals. Medium in which no amino acids were added was used as control. Only four amino acid groups support *S. citri* growth: (1) with 20 amino acids, (2) with glucogenic amino acids, (3) with non-essential amino acids, and (4) with uncharged polar R group amino acids. *S. citri* in group (1) grew significantly better than the other groups but populations in all groups reached 10^7 - 10^8 cells/ml. Using stepwise deletion from groups (3) and (4) we found that asparagine, cysteine, and glutamine are the three essential amino acids for *S. citri*. Aspartic and glutamic acids were unable to replace asparagine and glutamine, respectively.

A DEFINED-MEDIUM FOR THE *IN VITRO* CULTIVATION OF SPIROPLASMAS FROM HONEYBEE AND FLOWERS. C. J. Chang and T. A. Chen, Plant Pathology Dept., Rutgers University, New Brunswick, NJ 08903.

A defined-medium (CC-494) containing inorganic salts, amino acids, nucleosides, nucleotides, carbohydrates, vitamins, coenzymes, and lipids was developed to support the *in vitro* growth of spiroplasmas isolated from honeybee (HBS) and flowers (FS 23-6). In medium CC-494, HBS requires higher osmotic pressure (565-740 mOs) than FS (380-595 mOs) for optimal growth. The optimal pH for both spiroplasmas is 7.2-7.5 under which population reaches 10^8 - 10^9 cells/ml, but growth rates are slower as compared to those cultured in an undefined medium (C-3G). The doubling time for HBS is 7-8 hrs and for FS, 5-6 hrs. When amino acids, lipids or nucleosides are modified or deleted, the nutrient requirements for the two spiroplasmas is different. For example, FS grows in either ribo- or deoxyribo-nucleosides while HBS needs absolutely the presence of ribo-nucleosides. Using such a defined medium, therefore, the essentiality of nutritional requirements of HBS and FS can be elucidated.

ALTERATIONS IN MICRONUTRIENT PARTITIONING IN CADMIUM TREATED TOMATO PLANTS. Bruce B. Clarke, Ronald S. Harkov and Eileen Brennan. Department Plant Pathology, Cook College, P.O. Box 231, New Brunswick, N.J. 08903

The effect of Cd on the concentration and distribution of Zn, Mn and Fe in the tissue of tomato cv Rutgers was determined in sand culture. Plants received nutrient solution daily amended with 0, 0.25 and 0.75 ug Cd/ml as CdCl₂. Cadmium-treated plants exhibited no visual symptoms of Cd toxicity. The percent dry weight of leaf, stem, and root fractions was similar in all treatments. Cadmium content followed a root > leaf > stem gradient. Tissue concentrations increased with Cd treatment. Cadmium caused a significant reduction in the Mn and Fe concentrations (dry weight basis) of tomato roots. No significant changes in zinc concentration occurred in either root or shoot tissue. The significance of these results will be discussed as they relate to the mechanisms of cadmium toxicity.

PROTEIN TRANSFER/ANTIBODY PROBE TECHNIQUE SHOWS SIMILAR HOST (H) PROTEIN ENCAPSIDATED BY DIFFERENT TMV STRAINS. Candace W. Collmer and Milton Zaitlin, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

The U₁ strain of TMV has been previously shown to contain about one molecule per virion of a 26,500 dalton acidic host protein. Proteins from polyacrylamide gels were transferred electrophoretically to nitrocellulose paper which was then overlaid first with H protein antiserum and secondly with iodinated *Staphylococcus aureus* A protein, which binds to IgG molecules. Subsequent autoradiography showed the location of H protein on the original gel. Using this technique, we have shown that H protein is immunologically unrelated to viral coat protein, and that the two dissimilar TMV strains U₁ and C_c each encapsidate the identical H protein when replicated in Samsun tobacco. A third TMV strain (L) grown in tobacco or tomato also contains what appears to be the same protein on the basis of size and one-dimensional peptide mapping. We are currently using the antibody probe technique to confirm the identity of the L strain H protein and to search for H protein in TMV grown in other hosts.

HYPOVIRULENCE CONVERSIONS OF VIRULENT *ENDOTHIA PARASITICA* STRAINS DERIVED FROM MAINE ISOLATES. L. Conklin, R.J. Campana, and S.L. Anagnostakis, Department of Botany and Plant Pathology,

University of Maine, Orono, ME 04469, and The Connecticut Agricultural Experiment Station, New Haven, CT 06504.

Conversion of virulent strains of *Endothia parasitica* to hypovirulence requires hyphal anastomosis with *E. parasitica* strains that contain cytoplasmic hypovirulence determinants. To test hypovirulence conversion capacity, 24 virulent strains of *E. parasitica* isolated from 10 trees at 5 Maine sites were paired *in vitro* with 5 hypovirulent tester strains from Connecticut. Most of the Maine strains tested differed in vegetative compatibility, and none contained cytoplasmic hypovirulence determinants. Of 200 hypovirulence conversion trials, 57 (28.5%) were successful. Of the 57, 33 required 2 days or less to convert while 24 converted within 3-8 days. Some conversion rates varied in different tests using identical pairings. These tests demonstrate that some virulent Maine strains can be converted to hypovirulent strains that could be used to control cankers on American chestnut trees (*Castanea dentata*).

COMPOSTED SEWAGE SLUDGE AS A SOIL AMENDMENT: EFFECTS ON RHIZOBIUM NODULATION OF GARDEN BEAN. Daniel R. Cooley, and William J. Manning, Department of Plant Pathology, University of Massachusetts, Amherst, MA 01003.

Garden bean plants (*Phaseolus vulgaris* L. 'Contender') were grown in soil amended with digested sewage sludge, composted with wood chips, from Boston's Deer Island Treatment Plant. Ratios of compost to soil were: 0/10, 1/9, 2/8, 5/5, 9/1, or 10/0. Greenhouse pot tests included either non-pasteurized field soil plus compost amendments, or pasteurized field soil, plus compost amendments, plus Rhizobium inoculum (*Rhizobium phaseoli* Dangeard). When non-pasteurized soil was amended with compost, the average number of Rhizobium nodules and average nodule size varied inversely with the proportion of compost. When pasteurized soil was amended with compost, and inoculated with *R. phaseoli*, the average number of Rhizobium nodules was maximized at the 5/5 ratio, while average nodule size was constant for all amendment ratios.

WOUNDING EFFECTS OF MAUGET INSERTION TOOL INJECTIONS IN SUGAR MAPLE. Arthur C. Costonis, Systemics, Inc., 138 Mill Street, Westwood, MA 02090

This study compared the wounding effects of the Mauget insertion tool and a drill in sugar maple. The data demonstrated that the drill was less injurious to the maple tree tissue than the insertion tool. The average wound ratings for the drill and insertion tool at the stem-root buttress interface were 3.2 and 5.2, respectively. Injection wounds made in sound vigorous tissue by the drill or insertion tool were completely closed and compartmentalized within one and one-half growing seasons.

PRE-INCORPORATION OF FUNGICIDES INTO BEDDING PLANT MIX. M. L. Daughtrey and S. L. Wells, L.I. Hort. Res. Lab., Cornell Univ., Riverhead, NY 11901

Combinations of registered and experimental fungicides were incorporated into peat-lite mix for the control of damping-off fungi. Dry weights and germinations were determined for celosia, zinnia, impatiens, eggplant and tomato seeded into fungicide-treated mix. The effect of fungicide type and dosage was strongly correlated with plant type; celosia was particularly sensitive to fungicide presence. A bioassay with rows of celosia seedlings and inoculations of *Pythium ultimum* or *Rhizoctonia* sp. was used to measure relative effectiveness of chemical treatments. Lesan + Captan provided significant control of *Pythium* and did not reduce celosia germination or dry weight at the lowest dosage tested. In control of *Rhizoctonia* damping-off of celosia, both Benlate + Tersan SP & Lesan + Captan were relatively non-phytotoxic and effective at reducing fungus spread in a peat-lite medium.

THE INFLUENCE OF SOIL MOISTURE ON MACROSCOPIC SULFUR DIOXIDE INJURY TO PINTO BEAN FOLIAGE. Davids, J.A., D.D. Davis, and S.P. Pennypacker. Department of Plant Pathology, The Pennsylvania State University, University Park, 16802 USA.

The influence of soil moisture stress on sulfur dioxide (SO₂) injury to pinto bean foliage was investigated in relation to stomatal conductance rate, percent soil moisture, and plant water potential. Pinto bean plants were grown at four soil water potentials (-1/3, -1, -3, -5 atm) and exposed to 2.2 ppm SO₂ for 3 hours. Macroscopic injury was most severe on those plants grown at -1/3 atm soil water potential and became

progressively less as soil water potential decreased. Macroscopic injury was highly correlated with percent soil moisture. Both percent injury and soil moisture were highly correlated with stomatal conductance rate and water potential of the plants. Stomatal conductance rates of plants grown at -1/3 and -1 atm soil water potential decreased when the plants were exposed to 2.2 ppm SO₂, but were unaffected in plants grown at -3 and -5 atm soil water potential.

THE TOBACCO BLUE MOLD EPIDEMIC OF 1980. J. M. Davis, R. I. Bruck, C. E. Main, and F. A. Todd. Dept. of Plant Pathology, N. C. State University, Raleigh, NC 27650.

Tobacco blue mold (*Peronospora tabacina* Adam) attacked major tobacco production areas on the N. American continent during 1980. Geopolitical areas and date of first report of blue mold in the field were Cuba and Jamaica (ca. 1/1), Haiti (2/5), Honduras (2/25), Nicaragua (3/4), Florida (4/8), S. Carolina (4/28), N. Carolina (5/11), Virginia (5/30), Maryland (6/10), Tennessee (6/19), Kentucky (7/8), Penn. (7/11), Conn. (7/13), Mass. (7/13), Indiana (7/23), Ohio (7/25) and Canada (8/5). Considering the entire spatial and temporal aspects of the weather data, temperature, precipitation, and cloud cover-conditions were close to a 30-year normal during the period of the epidemic. Compared to 1979, May through July of 1980 were generally warmer, drier and sunnier while March 1980 was cooler, wetter, and less sunny. Prevailing winds normally became increasingly favorable for northward pathogen movement as the epidemic progressed.

THE INFLUENCE OF PRESSURE ON DISTRIBUTION OF SOLUBILIZED THIABENDAZOLE IN ELMS. S. J. Day and R. J. Campana, Department of Botany and Plant Pathology, University of Maine, Orono, ME 04469.

Erratic distribution of systemic chemicals injected or infused into elms has been attributed in part to variation in pressure when introduced, but comparative data are lacking. To evaluate the influence of pressure, 64 small elms (8-30 cm, dbh) were injected with pressure (6-7 N/cm²) or infused, by gravity flow, with Arbotect 20-S (thiabendazole). Experiments were performed in early or late summer, with or without sapstream continuity, and included four treatments: (1) pressure with-; (2) pressure without sapstream continuity; (3) gravity infusion with-; (4) gravity infusion without sapstream continuity. Sixty four trees were bioassayed for chemical distribution after 21 days. Applied pressure enhanced distribution of the fungicide significantly (P .05 level) in both early and late season applications. The data indicate clearly that better distribution of thiabendazole occurs with applied pressure than in its absence.

DIALLEL ANALYSIS OF OZONE RESISTANCE IN POTATO. N. E. De Vos, E. J. Pell, R. R. Hill, Jr., and R. H. Cole, The Pennsylvania State University and USDA-SEA-AR, University Park, PA 16802

The inheritance of foliar resistance to ozone (O₃) was studied in 14 cultivars of *Solanum tuberosum* L. using 2 sets of 7x7 diallel crosses. Resistant, intermediate, and susceptible parent clones were included in both crossing schemes. In each of 4 experiments for each diallel, approximately 500 3-week-old plants, including parent clones, S₁'s, and reciprocal F₁'s, were simultaneously exposed to 774 µg m⁻³ (0.40 ppm) O₃ for 3 hr in a controlled environment chamber at 21 C and 70% RH. General and specific combining ability were significant in both diallels, accounting for over 70% and 20%, respectively, of the variation among F₁'s. The susceptibility of S₁ families was generally equal to or greater than that of their parents. Maternal effects were significant in one diallel, but accounted for less than 5% of the variation among hybrids in either set of crosses.

YIELD RESPONSE OF SIX WINTER BARLEY CULTIVARS TO SOIL FUMIGATION. J. A. Frank, H. Cole, Jr., and H. G. Marshall, Dept. of Plant Pathology and USDA-AR, The Pennsylvania State University, University Park, PA 16802.

Six winter barley cultivars were planted in paired treatment blocks of fumigated (methyl bromide) and non-fumigated soil. Plots were further subdivided into foliar fungicide sprayed (tankmix of triadimefon and mancozeb) and non-sprayed subplots. Evaluations were made of plant stand, lodging, disease incidence (three soil-borne and five foliar pathogens), and several components of yield. Foliar diseases did not contribute to any significant yield loss. Fumigation by cultivar interactions were highly significant, with response of cultivars to soil-

borne pathogens contributing the major effect. Cultivars Pike, Post, and Maury had significantly lower yields following fumigation. Yields for Jefferson were not affected by fumigation while Barsoy and Boone had significant yield increases.

EFFECTS OF TEMPERATURE ON THE DEVELOPMENT OF THE ASCIGEROUS STATE OF *VENTURIA INAEQUALIS*. David M. Gadoury & W.E. MacHardy, Dept. of Botany & Plant Pathology, Univ. of N.H., Durham, N.H.

The ascigerous state of the apple scab fungus, *Venturia inaequalis*, was studied under laboratory and field conditions. Development was assessed by examination of pseudothecia *in situ*, ascospore discharge, and examination of pseudothecial contents. The thermal requirement shifted from an optimum of 10C for early growth to 20C for spore maturation. Temperature affected both productivity and rate of maturation. There was an inverse relationship between temperature and asci formed per pseudothecium, and between temperature and pseudothecia formed per unit of leaf area. A model was developed to predict ascospore maturity based on accumulation of degree days from the first appearance of mature spores. Most fungicide sprays are directed against the primary inoculum. An understanding of ascigerous development is critical to efficient disease management. A predictive model of ascospore maturation will allow management decisions to be made on a scientific basis, without constantly monitoring ascospore development.

AERIAL CONTAMINATION OF ASPARAGUS FLOWERS, FRUIT AND SEED BY *FUSARIUM OXYSPORUM* AND *FUSARIUM MONILIFORME*. Robert L. Gilbertson, and William J. Manning, Department of Plant Pathology, University of Massachusetts, Amherst, MA. 01003.

The incidence of airborne spores of *Fusarium oxysporum* and *F. moniliforme* was determined in asparagus fields, using plates of PCNB medium or Vaseline-coated slides. Levels of *F. oxysporum* in air remained low throughout the season, while *F. moniliforme* incidence increased as the season progressed. Few isolates of *F. oxysporum* were pathogenic on asparagus seedlings (*Asparagus officinalis* L.) on Hoagland's agar, while all isolates of *F. moniliforme* were pathogenic. When randomly sampled seeds and fruits were sampled, up to 10% were contaminated by *F. moniliforme* and very few by *F. oxysporum*. Female flowers were artificially inoculated with spores of *F. moniliforme* or *F. oxysporum* in the field. Resulting fruits and seed were extensively contaminated by *F. moniliforme*, but not *F. oxysporum*. Airborne spores of *F. moniliforme* are a source of contamination for asparagus flowers and resulting fruit and seeds.

INHERITANCE OF RESISTANCE IN CORN TO AN ISOLATE OF *COCHLIOBOLUS CARBONUM* RACE 3. A. H. Hamid, J. E. Ayers and R. R. Hill, Jr., Dept. of Plant Pathology, The Pennsylvania State University, and USDA-SEA-AR, University Park, PA 16802.

Three sets of diallel crosses involving 14 corn inbred lines with differing levels of resistance of *Cochliobolus carbonum* race 3 were tested. The inbreds and 114 F₁ lines were screened for resistance in a growth chamber against a virulent isolate of the fungus. Lesion length, disease efficiency (number of successful infections from quantified inoculum) and sporulation capacity (number of conidia produced per unit area of lesion at 4 days) were utilized as resistance parameters. Average heterosis and additive gene effects were significant. Variation due to cytoplasmic factors and specific combining ability was not significant. Narrow-sense heritability estimates for lesion length, disease efficiency and sporulation capacity were 60%, 83%, and 36%, respectively, indicating that these traits can be incorporated into commercially grown cultivars.

THE STABILITY OF HORIZONTAL RESISTANCE TO ISOLATES OF *COCHLIOBOLUS CARBONUM* RACE 3. A. H. Hamid, J. E. Ayers, and R. R. Hill, Jr., Dept. of Plant Pathology, The Pennsylvania State University, and USDA-SEA-AR, University Park, PA 16802.

Resistance of corn inbred lines to 6 virulent isolates of *Cochliobolus carbonum* race 3 was estimated by determining the effects of the lines on 3 components of parasitic fitness; disease efficiency (number of successful infections from quantified inoculum), lesion length, and sporulation capacity (number of conidia produced per unit area of lesion at 4 days). Differences among host genotypes were significant when tested against these isolates. Similarly, isolates differed significantly in the degree of virulence on the host lines. Isolate x host interactions were significant for the 3 fitness traits suggesting that isolates rank differently on various hosts. Regression analyses were used to measure the stability of resistance. Re-

sistance of some lines was stable for all isolates in each trait. Resistance was defined as stable when the regression coefficient was zero and deviations from regression line were minimal.

VARIATION IN PARASITIC FITNESS AMONG ISOLATES OF *COCHLIOBOLUS CARBONUM* RACE 3. A. H. Hamid, J. E. Ayers, R. D. Schein and R. R. Hill, Jr., Dept. of Plant Pathology, The Pennsylvania State University, and USDA-SEA-AR, University Park, PA 16802.

Variation in parasitic fitness of *Cochliobolus carbonum* race 3 was determined by measuring the number of successful infections from a quantified inoculum of the fungus placed on corn inbred lines (DE), the length of lesions (LL), and the number of conidia produced at 4 days (SC). Differences among isolates were significant. Isolate x host interactions were significant for all these fitness attributes. After inoculation, LL progressed linearly for approximately 10 days but the rates of increase differed among host-pathogen combinations. Heritability estimates for DE, LL, and SC were 77%, 87%, and 60%, respectively. High heritabilities for these traits may enable natural selection to increase the parasitic fitness of the pathogen.

THE INFLUENCE OF SUMMER FALLOW ON THE SURVIVAL OF *XIPHINEMA AMERICANUM* IN A PEACH ORCHARD. M.B. Harrison and R.C. Lamb, Dept. of Plant Pathology, Cornell University, Ithaca, NY 14853, and Dept. of Pomology and Viticulture, Cornell University Experiment Station, Geneva, NY 14456.

Summer fallow with weed control achieved by either frequent cultivation or by an herbicide or fallow without weed control were compared for their influence on the survival of a population of *Xiphinema americanum* in a sandy loam soil from which peach trees had recently been removed. Plots 4.5 m by 6.0 m were sampled at approximately monthly intervals. Nematodes were extracted and counted soon after sampling. Soil from the initial sampling was placed in 150 mm pots with rooted strawberry runner plants. *Xiphinema* populations declined 9 weeks after initial sampling. In plots without weed control the *Xiphinema* population after 17 weeks increased to or exceeded the initial population. The nematode population in the pots with strawberry plants did not equal that in the weed plots.

AN APPARATUS FOR CONTROL OF ATMOSPHERIC WATER POTENTIALS IN STUDIES OF *PERONOSPORA PARASITICA* AND OTHER FOLIAR PATHOGENS. H. Hartmann, J.C. Sutton and G.W. Thurtell*, Departments of Environmental Biology and *Land Resource Science, University of Guelph, Guelph, Ontario, Canada, N1G 2W1.

The apparatus consisted of two precision (± 0.05 C) water baths, the first containing three humidifiers (gas dispersion tubes in copper cylinders) and a water trap, and the second a sample chamber (brass, 15 x 33 x 15 cm). An air stream regulated at 1 L/min was passed through a copper coil in the first bath, and then saturated in the humidifiers. The temperature of the saturated air was increased by passage through a copper coil in the second bath. The air then passed through the chamber. The dew point of air expelled from the chamber was measured continuously with a dew point hygrometer. Atmospheric water potentials were controlled within ± 10 bars (about ± 0.1 C dew point) for ≤ 48 h. In the chamber, *P. parasitica* sporulated on intact cabbage seedlings only at relative humidities $\geq 97\%$ at 18 C (-41 bars). Spores produced at 18 C and -41.0 to -13.5 bars required free water for germination.

PACHYSANDRA, A NEW RESERVOIR HOST OF ALFALFA MOSAIC VIRUS. D. E. Hershman and E. H. Varney, Department of Plant Pathology, Cook College, Rutgers University, New Brunswick, NJ 08903.

A line pattern and ringspot disease of *Pachysandra terminalis* is known from several locations in central New Jersey. A virus isolated consistently from infected plants was readily transmitted by sap inoculation to selected herbaceous plants in the greenhouse. Symptoms were suggestive of those caused by alfalfa mosaic virus (AMV). A comparative study of the pachysandra virus (PV) and a known culture of AMV (ATCC PV-92) showed no significant differences in host range and symptomatology. A thermal inactivation point between 55 and 60C, a dilution end point between 10^{-3} and 10^{-4} , and longevity *in vitro* of 3-4 days at room temperature are within limits reported for AMV. Electron microscopy of purified PV revealed bacilliform particles characteristic of AMV. A positive serological reaction was demonstrated between an antiserum to AMV and the PV. The virus was transmitted in a stylet-borne manner by the peach aphid, *Myzus persicae*. *P. terminalis* is another important reservoir host of AMV, particularly in the vicinity of home gardens.

HISTOLOGICAL EVIDENCE FOR THE PRESENCE *IN SITU* OF *CLADOSPORIUM FULVUM* GLYCOPROTEIN TOXIN IN BOTH COMPATIBLE AND INCOMPATIBLE INTERACTIONS WITH TOMATO. Verna J. Higgins, Dept. of Botany, Univ. of Toronto, Toronto, Ontario. M5S 1A1.

Inoculation of tomato cultivars with races of *Cladosporium fulvum* by conidial injection into the intercellular spaces produced the expected disease reactions. Histological study of leaves sampled up to 6 or 8 days post-inoculation revealed localized development of callose wall deposits in those host cells in direct contact with a conidium or a young germ tube. In compatible interactions, germ tubes eliciting the callose response often continued to develop, usually by producing a new branch which failed to elicit a visible host response. In incompatible interactions, germ tubes on encountering the callose response either did not develop further or they evoked a response in the next cell contacted and ceased growth. *In vitro*, the outer surface of germ tubes was readily stained with FITC-labelled Con A. It is suggested that a previously described callose-inducing glycoprotein toxin is localized on the fungal wall surface and that its activity is suppressed in the compatible interaction.

DOSE-RESPONSE RELATIONSHIPS OF PINES AND SPRUCES TO *GREMMEIELLA ABIETINA*. G.W. Hudler, G.R. Knudsen, and M.A. Beale, Dept. of Plant Pathology, Cornell Univ., Ithaca, NY 14853.

Three-yr-old red, white, and Scots pines and white and Norway spruces were tested for susceptibility to *Gremmeniella abietina* at different inoculum dosages. Seedlings were planted on 29-31 May 1979 in plots of 20 seedlings per plot. On 21 June 1979, they were sprayed to runoff with aqueous suspensions of 10^2 , 10^3 , 5×10^3 , 10^4 , or 10^5 conidia/ml or with water. All treatments were replicated five times. Spore retention on seedlings was estimated by calculating the product of inoculum concentration and difference in weight of representative seedlings before and after inoculation. Infected seedlings were counted in May-July 1980 as symptoms developed. Disease in red pine ranged from 4% (water) to 98% (2.9×10^5 conidia/seedling). Scots pine infection ranged from 1% (water) to 52% (2.6×10^5 conidia/seedling), and white pine infection ranged from 0 (water) to 68% (1.6×10^5 conidia/seedling). No symptoms developed on white or Norway spruce at inoculum levels up to 3×10^5 conidia/seedling.

PHYSIOLOGICAL AND HISTOLOGICAL CONTRAST BETWEEN OZONE TOLERANT AND SUSCEPTIBLE POTATO CULTIVARS. B.L. Illman and E.J. Pell. Dept. of Plant Pathology and Center for Air Environment Studies. The Pennsylvania State University, University Park, PA 16802.

Foliar conductance of 'Norchip' and 'Cherokee', ozone (O_3) tolerant and susceptible cultivars, respectively, were determined before, during, and after a 3-hr exposure to $499 \mu g m^{-3} O_3$. Conductance of 'Norchip' did not change, while decreases in conductance were observed on leaves of 'Cherokee' which were severely injured at the end of the exposure. Exclusion would not appear to explain O_3 tolerance of 'Norchip'. A histological study was conducted to characterize the differential foliar response of the cultivars. Abaxial flecking of 'Cherokee' leaves reflected collapse of spongy mesophyll cells. Bifacial necrosis was associated with collapse of palisade mesophyll cells as well. Collapsed cells stained intensely with safranin and their autofluorescence was yellow-brown in contrast to the yellow-green of cells of nonexposed tissue. While fewer numbers of cells of 'Norchip' were injured, the characteristics of the cellular response resembled that of 'Cherokee'.

AUTOFLUORESCENCE AND PHENYLALANINE INCORPORATION IN CELLS POSSESSING PAPILLAE THAT BLOCK FUNGAL INGRESS. A.F. Imhoff, J.R. Aist and H.W. Israel. Dept. of Plant Pathology, Cornell University, Ithaca, NY 14853

Oversized papillae, preinduced by *Erysiphe graminis* f.sp. *hordei* in coleoptile cells of a compatible cultivar of *Hordeum vulgare* can resist subsequent penetration by *E. graminis*. To study the molecular basis of this resistance, autofluorescence and phenylalanine (phe) incorporation were measured. When irradiated with UV light, oversized papillae autofluoresced more intensely than did normal papillae or cell walls not associated with papillae, suggesting the presence of phe metabolites. Total incorporation of phe by inoculated coleoptiles exceeded that of non-inoculated ones. Partition of coleoptile cell homogenates into cell wall and protein components indicated that the observed difference was principally due to incorporation of phe into soluble proteins. These preliminary results suggest that phe metabolites are not preferentially incorporated into cell walls bearing oversized papillae.

RHIZOSPHERE SOIL AND APPLE ROOTS AS SOURCES OF INOCULUM FOR AN APPLE REPLANT DISEASE. B. A. Jaffee, G. S. Abawi¹ and W. F. Mai. Departments of Plant Pathology, Cornell University, Ithaca, NY 14853 and ¹Geneva, NY 14456.

Ten-day-old apple seedlings (cv Northern Spy) were transplanted into pasteurized orchard soil (PS, 30 min at 75C) amended with washed feeder roots (WFR, 1.8g/500 cm³ soil) or rhizosphere soil (RS, ca. 5 g dry wt/500 cm³ soil) of apple seedlings. The WFR and RS were obtained from apple seedlings grown in PS alone and PS plus 5% (V:V) of nontreated soil (PS+NS) with a known history of apple replant disease. Addition of WFR or RS (whether from PS or PS+NS) caused moderate and severe stunting, respectively. However, only the seedlings growing in soil amended with WFR or RS obtained from PS+NS exhibited root necrosis. *Cylindrocarpon lucidum* and *Pythium irregulare* were isolated from necrotic areas suggesting their involvement in the disease. Nevertheless, we propose that the primary causal agent is a nonparasitic rhizosphere organism which is suppressed but not eradicated by soil pasteurization. This agent does not pass through a 0.2 µm filter and is inactivated in aqueous suspension by 60C for 10 min.

OZONE SLOWS THE GROWTH RATE OF SILVER MAPLE LEAVES. Keith F. Jensen, USDA, P.O. Box 365, Delaware, OH 43015.

One-year-old silver maple seedlings were fumigated for 12 hours per day with either 0, 0.1, or 0.2 ppm ozone. As new leaves were formed in the treatment chambers, representative leaves were selected from each treatment having Leaf Plastochron Index values from 0 to 1.5. Dots were placed on each leaf along the midrib at approximately 1-mm intervals. Each leaf was then photographed at the same time on three successive days. Changes in elementary leaf length were determined by measuring the distance of the dots from the leaf tip. Ozone fumigation slowed leaf elongation and hastened leaf maturity. Ozone could retard height and weight increases through these processes because leaf size is often directly correlated with seedling size and weight.

CONTROL OF LETTUCE DROP WITH A TRANSPLANT DRENCH AND/OR FOLIAR SPRAYS OF VINILOZOLIN. S.A. Johnston, Rutgers Res. & Dev. Center, Bridgeton, N.J. 08302.

The efficacy of the fungicide vinclozolin (Ronalin) was field tested against *Sclerotinia* sp. on lettuce as foliar sprays and soil drenches. Plots received 3 foliar sprays at 10-day intervals, with sprays initiated shortly after transplanting or after thinning. Rates tested were 0.56, 0.84 and 1.12 kg/ha. At 0.56 kg/ha there was 56, 71, 83 and 69% disease control (PDC) in the spring '78 & '79 and fall '78 & '79 tests. At 0.84 kg/ha there was 87, 77 and 75 PDC in the fall '78 & '79 and spring '80 tests. At 1.12 kg/ha there was 81, 100 and 73 PDC in the spring '78 and the fall '78 & '79 tests. A fungicide drench (spring '80) was applied to flats containing lettuce transplants 4 days prior to transplanting and/or 11 days after transplanting in the field. Disease control was excellent at 0.84 and 1.12 kg/ha when applied as a greenhouse and field drench (93 PDC) and unsatisfactory when applied at 0.84 kg/ha as a field drench only (29 PDC).

GERMINATION OF *GREMMENIELLA ABIETINA* CONIDIA INHIBITED BY EPIPHYTIC PSEUDOMONADS. G.R. Knudsen and G.W. Hudler, Dept. of Plant Pathology, Cornell Univ., Ithaca, NY 14853

Strains of *Pseudomonas fluorescens* (R10A), *P. fluorescens* group (R9D), and *P. aeruginosa* (R10B) were collected from surfaces of current year's shoots of red pine. A strain of *P. fluorescens* group (S5A) was collected from Scots pine. An aqueous suspension of *Gremmeniella abietina* conidia (10⁵ conidia/ml) and bacteria (7x10⁷ CFU/ml) was adjusted to pH 5.6 and pipetted onto 1.5% Difco Bacto agar. After 48hr at 20C, germination of conidia mixed with strain R10A, R9D, R10B, or S5A was 2%, 6%, 1%, and 0%, respectively, compared with 95% for the bacteria-free control. In another experiment, 1cm³ sterile blocks of 1.5% Difco Bacto agar were incubated for 48hr on 0.2µm filters over cultures of each of the four strains of bacteria. The sterile blocks were then removed from the filters, and a drop of conidial suspension was placed on each block. After 48hr at 20C, germination ranged from 10% to 21%, compared to 92% on control blocks. Inhibition of germination was apparently due to a diffusible antibiotic substance.

MECHANISMS OF OVERWINTERING OF PUCCINIA CORONATA CDA. ON *LOLIUM PERENNE* L. IN NEW JERSEY. David M. Kopek and Philip M. Halisky. Rutgers University, New Brunswick, N.J. 08903

In studies with the crown rust fungus, *Puccinia coronata*, the rare occurrence of teliospores in New Jersey was observed. An initial observation was made in December, 1979 on plants of *Lolium perenne* previously known to bear uredospores. Teliospores occurred both in field nurseries as well as on plants removed to the greenhouse. This observation of the telial stage (III) of crown rust on *Lolium perenne* constitutes a new state host record of this relatively rare spore form in New Jersey. Since the alternate host, *Rhamnus cathartica* L., grows as an escaped species in our state, the evolution of new pathogenic races and the formation of indigenous uredospores are both possible. Results of overwintering studies indicate that viable mycelial infections may survive adverse winter field conditions.

EFFECTS OF CHEMICAL SEED TREATMENTS ON THE RHIZOCTONIA DISEASE COMPLEX OF WHITE POTATO. S. S. Leach, USDA, SEA/AR, Department of Botany and Plant Pathology, University of Maine, Orono, Maine 04469, and J. A. Frank, USDA, SEA/AR, Department of Plant Pathology, The Pennsylvania State University, University Park, Pennsylvania 16802.

Field studies were conducted in 1978 and 1979 to determine if seed treatments could reduce losses caused by *R. solani*. Since pentachloronitrobenzene (PCNB), thiabendazole, and SD53968 reduced or prevented growth of the fungus from sclerotia in laboratory tests, these materials, and other promising compounds were evaluated. Treatments were applied from 1,500 - 100,000 ppm in 20 second dips or dusts to potato tubers with 25% or more of their surface covered with sclerotia. Field plot locations were selected based on low *R. solani* content to reduce interaction of soil-borne inoculum. The results showed that PCNB, thiabendazole and SD53968 applied at 75,000, 6,000 and 10,000 ppm respectively, produced significantly less symptoms in plants and tubers. Seed treatments also reduced rate of infestation or reinfestation of "clean potato soils."

DETECTION OF A NON-STRUCTURAL VIRAL PROTEIN SYNTHESIZED IN TMV-INFECTED *NICOTIANA TABACUM*. Deborah A. Leonard and Milton Zaitlin, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Tobacco mosaic virus (TMV) is a plus-strand RNA virus. The coding regions, which account for 87% of the TMV genome, have been defined by *in vitro* translation of viral RNA. Separation of proteins from TMV-infected leaf tissue by two dimensional electrophoresis has permitted detection of a virus-specific protein not seen in previous studies. A comparison of proteins from leaves infected with different TMV strains suggests that this virus-specific protein is the 30,000 d protein synthesized by *in vitro* translation of TMV RNA. Time course experiments show maximum relative accumulation of this protein late in the replication process. Possible functions of this protein in TMV replication and pathogenicity will be discussed.

SMALL FIELD PLOT EPIDEMIOLOGICAL STUDIES ON BLUE MOLD OF TOBACCO IN NORTH CAROLINA. C. E. Main, R. I. Bruck, J. M. Davis, and G. V. Gooding. N. C. State University, Raleigh, NC 27650.

Tobacco blue mold (*Peronospora tabacina*) occurred via natural inoculum at Clayton, NC on June 6, 1980. Lesion number, size, expansion rate, sporulation and disease progress were monitored in relationship to canopy microclimate and regional climatic events. Three fungicides, fungicidal rate and spray intervals were used to regulate the progress of epidemics in replicated 80-plant plots. Overhead irrigation was utilized to extend leaf wetness periods. Disease progress curves were well correlated with synoptic weather conditions. Disease persisted under conditions previously considered limiting (daytime temp > 85°F and few cloudy, rainy days) indicating the possibility of a temperature tolerant strain of the pathogen. Ridomil 2EC applied either pre-plant soil incorporation (1 qt or 1 pt/acre) or foliar (1 pt/acre) at 14-day intervals prophylactically and therapeutically controlled blue mold. Manzate 200 at 2.5 lbs(a.i.)/acre reduced disease while streptomycin SO₄ (Agri-strep type D) was ineffective in preventing disease progress.

SOME CHEMICAL AND PHYSICAL CHARACTERISTICS OF BACTERIAL WETWOOD IN ELM. C. W. Murdoch and R. J. Campana, Department of Botany and Plant Pathology, University of Maine, Orono, ME 04469.

Bacterial wetwood of elm is not well understood as a disease phenomenon. To elucidate its nature further, certain chemical and physical properties of infected and noninfected wood were

explored. Comparative data from wetwood and healthy wood were obtained on: moisture content, electrical resistance, gas pressures, pH, cation content of Na⁺, K⁺, Ca⁺⁺, Mg⁺⁺; and osmotic potential of sap. Moisture content was determined by oven dry weight; resistance by Shigometer, pH by meter, cation analysis by atomic absorption spectrophotometer, and osmotic potential by cryoscopic method. In wetwood, moisture content and gas pressures were significantly higher; but electrical resistance and osmotic potential of wetwood capillary liquid were significantly lower than in contiguous, healthy wood. Cation content and pH of wetwood capillary liquid were higher than values of expressed sap from adjacent sapwood tissue. The data indicate that water movement into wetwood tissue from healthy wood is osmotic in nature.

SOME PHYSICAL AND MICROBIOLOGICAL CHARACTERISTICS OF WET POCKETS IN WHITE PINE (*PINUS STROBUS* L.). C. W. Murdoch and R. J. Campana, Department of Botany and Plant Pathology, University of Maine, Orono, ME 04469.

Wet pockets in white pine are associated with kiln drying and planing defects in lumber. To determine whether this phenomenon is a disease, or non-pathological in nature, physical and microbiological characteristics of normal wood and wet pockets were examined. Comparative data were obtained on: color; odor; moisture content; and electrical resistance. Color and odor were determined by direct inspection; moisture content by moisture meter; resistance by Shigometer; and microorganisms by laboratory isolation. Color, and odor of wet pockets were similar to those from normal wood. No bacteria or fungi were associated with wet pockets. Moisture content and electrical resistance were higher and lower, respectively, in affected than in normal wood. Results indicate that wet pockets are of a non-pathological nature, and involve properties of capillarity. A model is proposed to explain wet pocket formation.

TOXIC SYNERGISM IN VERTICILLIUM WILT OF TOMATO. Harry Mussell & Patricia C. Stilwell, Boyce Thompson Institute at Cornell, Ithaca, NY 14853.

Aqueous extracts of acetone powders from cultures of *Verticillium albo-atrum* caused all of the symptoms of *Verticillium* wilt when applied to tomato cuttings. When fractionated on Sephadex G-75, this preparation yielded one toxic fraction which contained endoPG activity; however, this fraction generated only slight foliar necrosis and chlorosis. A second fraction with an average molecular weight of ca. 4000 Daltons was not toxic when administered alone, but was extremely toxic if the cuttings were pretreated with purified endoPG. Acid hydrolysis of *Verticillium* mycelium also yielded a soluble fraction which was toxic only to cuttings pretreated with endoPG. These results imply that a breakdown product of *Verticillium* mycelium may function as a toxin in *Verticillium* wilt of tomato. The endoPG generated by the fungus can sensitize tomato plants to this toxin, and in combination with the toxin, may be responsible for all of the symptoms of *Verticillium* wilt of tomato.

ELECTRICAL RESISTANCE AND STEM WATER POTENTIAL IN CERATOCYSTIS ULMI-INFECTED AMERICAN ELMs. Dennis Newbanks and Terry A. Tattar. Harvard Forest, Petersham, MA 01366 and Dept. of Plant Pathology, Univ. of Massachusetts, Amherst, MA 01003.

An inverse relationship exists between stem water potential (ψ) and electrical resistance (ER), corrected to a standard temperature of 20° C (CST), in healthy American elm (*Ulmus americana*) ($r = -.89$ to $-.96$). Stem ψ and ER (CST) of elm saplings were measured at 1 to 3 day intervals during the course of infection by *Ceratocystis ulmi* (Buism.)C. Moreau. In each of 4 experiments ER of the infected plants increased as ψ decreased. In 2 of these experiments ER of the infected plants was significantly greater than that of the control plants on at least the last 3 measurement dates. Stem ψ of the infected plants was significantly lower than that of the control plants on at least the last 3 measurement dates in all 4 experiments. The presence of wound-associated discolored wood and wetwood in some of the test trees may account for the breakdown of the ER- ψ relationship in 2 of the 4 experiments.

METHODS OF DISEASE INDEXING ON A MOWED CROP TO ESTIMATE APPARENT INFECTION RATES. F. W. Nutter, Jr., H. Cole, Jr., and R. D. Schein, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Disease assessments for leafspot (*Drechslera poae*) on stands of

Kentucky bluegrass 'K109' under two nitrogen regimes were conducted by sampling whole tillers and leaf clippings just prior to each mowing. Number of infected units and the number of lesions per 100 units (tillers or clippings) were recorded. In spite of lesions being continually mowed off the leaves, incidence and total lesion counts increased over time. The epidemic began 4 days earlier on plots receiving nitrogen and reached maximum disease levels 10 to 14 days earlier compared to plots not receiving nitrogen. Apparent infection rates (units/day) for *D. poae* on fertilized plots were $r = 0.128$ (tillers) and $r = 0.111$ (clippings) while apparent infection rates were lower for plots not receiving nitrogen ($r = 0.07$ and $r = 0.05$). These results indicate that apparent infection rates can be estimated on mowed crops to quantify the effects of cultural practices and disease control strategies upon epidemics.

A RELATIONSHIP BETWEEN INCIDENCE AND SEVERITY OF HELMINTHOSPORIUM LEAFSPOT (*DRECHSLERA POAE*) ON TWO KENTUCKY BLUEGRASS VARIETIES. F. W. Nutter, Jr., R. D. Schein, and H. Cole, Jr. Dept. of Plant Pathology, The Pennsylvania State University, University Park, Pennsylvania 16802

The relationship between incidence and severity of leaf spot (*Drechslera poae*) on the Kentucky bluegrass varieties 'Merion' (resistant) and 'K109' (susceptible) was determined by sampling whole tillers and leaf clippings prior to each mowing. The 'K109' plots were split into treatments receiving nitrogen fertilizer and plots not receiving nitrogen. Severity was highly correlated with incidence for both varieties. The relationship remained high for the 'K109' plots whether or not nitrogen was applied. Regression coefficients of determination for the experiments ranged from 86.1 to 94.5 per cent. Either whole tillers or leaf clippings could be used to predict disease severity of the leaf spot phase of *D. poae* based upon incidence data. These results suggest that incidence data could be used to evaluate disease control strategies such as the use of improved bluegrasses for resistance to *D. poae* or the use of fungicides.

DEVELOPMENT OF NECROPHYLACTIC PERIDERM IN YOUNG SHOOTS OF FAGUS GRANDIFOLIA. William D. Ostrofsky and Robert O. Blanchard, Dept. of Botany & Plant Pathology, University of New Hampshire, Durham, 03824.

Necrophylactic periderm development in current year shoots of American beech (*Fagus grandifolia* Ehrh.) was studied over an 8 week period. Three weeks after budbreak, but several weeks before a normal periderm had fully developed, shoots were either wounded, inoculated with microconidia of *Nectria coccinea* var. *faginata*, or wounded and inoculated. Initiation of a necrophylactic periderm around both inoculated and uninoculated wounds occurred as divisions in the cortical parenchyma within 7 days after wounding. Microconidia germinated, and the fungus was able to infect parenchyma adjacent to the wound. Twenty-one days after wounding, long files of parenchyma had been produced, resulting in the sloughing of all tissues directly injured by wounding or infected by the fungus. Slow growth of the fungus with respect to necrophylactic periderm development may explain the inability of the pathogen to infect most natural wounds on American beech.

THE POSSIBLE ROLE OF FIXED COPPERS IN COMBINATION WITH ETHYLENEBISDITHIOCARBAMATES FOR CONTROL OF PSEUDOMONAS SYRINGAE PV. TOMATO. Ian M. Parsons and L.V. Edgington, Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada, N1G 2W1.

Several workers have found that when ethylenebisdithiocarbamate chemicals (EBDCs) were used in combinations with the fixed coppers, field control of bacterial speck was better than when either chemical was used alone. A TLC biochromatographic analysis showed ethylenethiram monosulfide (ETM) to be the antibacterial component in the EBDCs. The possibility that the fixed coppers had a stabilizing effect upon ETM under field conditions was explored. Analysis of residues from sprayed plants showed that the ETM from the EBDCs alone lasted as long or longer than the ETM in the combinations.

THE EFFECTS OF BAYLETON ON THE FOLIAR GROWTH OF *POA ANNUA*. B. W. Pennypacker, P. L. Sanders, L. V. Gregory, E. P. Gilbride, and H. Cole, Jr., Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Three-week-old *P. annua* seedlings were placed in growth chambers under 4 environmental regimes: hot/wet, hot/dry, cool/wet, and cool/dry. Half of the pots were drenched with 114g a.i. Bay-

leton/93 m² immediately prior to placement in environmental chambers. Foliar dry weight of 10 plants/treatment was determined weekly for 7 weeks. Differences in dry weight between treated and untreated foliage did not occur under cool/wet, cool/dry, or hot/dry conditions; however, the foliar dry weight of Bayleton-treated *P. annua* grown under hot/wet conditions was only 44% that of the untreated grass. Foliar dry weight of Bayleton-treated grass was statistically identical under hot/wet and hot/dry conditions, indicating that the foliar growth rate of Bayleton-treated *P. annua* was not influenced by the amount of water available under hot conditions. These findings may explain, in part, the steadier growth rate and improved field survival of Bayleton-treated *P. annua* in the fluctuating summer environment.

A VIRUS DISORDER OF GARLIC IN QUEBEC. J. F. Peterson, Plant Science Dept., McDonald Campus of McGill University, Ste. Anne de Bellevue, Quebec H9X 1C0.

Many commercial varieties of garlic (*Allium sativum* L.) in major growing areas are virus-infected. For at least two seasons growers have found severe symptoms resembling those of garlic yellow stripe (California) or garlic stripe mosaic virus (Taiwan) in crops from bulbs imported from South America. Bulbs develop poorly, store badly, and grow poorly when replanted. Negatively stained leaf dip preparations under EM contain moderately flexuous rod-shaped particles, some exceeding 1 µm, longer than usual for the potyvirus group in which the above garlic viruses are listed. No virus has previously been recorded on garlic in Quebec, where it is a specialty crop on limited acreage.

TWO WEED SPECIES AS HOSTS AND POTENTIAL INOCULUM SOURCES OF COLLETOTRICHUM COCCODES. R. N. Raid, S. P. Pennypacker, and A. A. MacNab, Dept. of Plant Pathology, The Pennsylvania State University, University Park, PA 16802.

Colletotrichum coccodes is generally considered to be the primary causal agent of tomato anthracnose. One control measure currently recommended for anthracnose is crop rotation; however, this control measure has met with limited success. It has been suggested that *C. coccodes* may survive in ways other than its assumed overwintering as sclerotia on tomato debris. During the 1980 growing season, senescent and/or necrotic stems and leaves of common weed species were collected from a tomato field and examined for colonization by *C. coccodes*. After 22 hours in a dew chamber at 24 C, acervuli were observed on two weed species, i.e. redroot pigweed (*Amaranthus retroflexus*), and common lambs-quarter (*Chenopodium album*). Sclerotia were also observed on redroot stems and lambsquarter leaves. This is the first report of *C. coccodes* on either of these two species and may help explain the persistence of anthracnose over long rotations.

FIELD EXPOSURE OF SOYBEANS AND HYBRID POPLAR SEEDLINGS TO SULFUR DIOXIDE AND OZONE USING A CHAMBER-LESS DELIVERY SYSTEM. P.B. Reich, R.G. Amundson, D. Sawicki, L.I. Carlsson, and J.P. Lassoie, Boyce Thompson Institute and Dept. of Natural Resources, Cornell University, Ithaca, N.Y. 14853

A chamber-less fumigation system was used in central New York in 1979 and 1980 to expose unenclosed field-grown plants to sulfur dioxide and ozone. In 1979, during podfill, Hark soybeans were exposed for 55 h on 12 days to a linear gradient of both ozone and sulfur dioxide. Plants were harvested from areas exposed to ambient, low, medium and high levels of both pollutants. In 1980 the same system was used to deliver ozone and sulfur dioxide to soybeans and hybrid poplar seedlings, but instead of a linear gradient, 9 treatments were used in a 3x3 factorial design (ambient, low and high levels of sulfur dioxide and ozone). Fumigations in 1979 caused significant reductions in soybean yield. Preliminary analysis of 1980 data indicate reduced biomass production in hybrid poplar as a result of the pollutant exposures.

CELL STABILITY INDEX FOR ANALYSIS OF MEMBRANE POTENTIAL IN ELM LEAVES. J. S. Shipman, R. O. Blanchard, and F. A. Peterson, Department of Botany and Plant Pathology, University of New Hampshire, Durham, New Hampshire 03824.

Membrane potentials of leaf cells are being used to detect relative resistance of plants to specific pathogens and to elucidate mechanisms of host-parasite interactions. In our studies with elm diseases, a "normal" standard was needed, since the membrane potential of a typical elm cell may vary several millivolts. Therefore, we developed a cell stability index based on membrane potential to determine the usability of an individual cell for further experimentation. The formula is: $Q = \frac{x}{200} + \frac{10}{y} + z$ where

Q = the cell stability index, x = the absolute value of the change in millivolts from maximum to minimum, y = the time in minutes and z = the number of dips in membrane potential. The smaller Q , the more stable the cell. In development of the formula, time course experiments were done to select a method of tissue preparation which provided the greatest percentage of stable cells.

EFFECTS OF FUSARIUM AND PYTHIUM ON YIELD COMPONENTS OF WHITE BEAN. D.W. Sippell and R. Hall, Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada, N1G 2W1.

The effects of *Fusarium solani* f. sp. *phaseoli* at 500 conidia/mL of potting mix, *F. oxysporum* at 1000 conidia/mL and *Pythium ultimum* at 100 sporangia/mL, singly and in all combinations, on seed yield components of white beans were tested in field micro-plots. *Fusarium oxysporum* alone did not significantly reduce yield, nor did it affect yield when in combination with the other fungi tested. *Pythium ultimum* reduced seed yield 31% by reducing the number of pods per plant but not the seed weight per pod. *Fusarium solani* f. sp. *phaseoli* reduced seed yield 42% by reducing the weight of seed per pod but not the number of pods per plant. In combination, these two pathogens reduced seed weight per plant 52% by reducing both the number of pods per plant and the weight of seed per pod.

THE EFFECT OF CADMIUM AND ZINC TREATMENTS ON THE ACCUMULATION OF THESE ELEMENTS IN RUTGERS TOMATO PLANTS. Gretchen Smith and Eileen Brennan, Dept. of Plant Pathology, Cook College, P.O. Box 231, New Brunswick, N.J. 08903

There is no consensus regarding the zinc-cadmium interaction in vegetation. We adopted the split-root technique for growing experimental plants in sand culture in order to eliminate reactions between the two elements in the substrate or in the roots. One half of each root system of Rutgers tomato plants was given Cd-amended nutrient solution (0, 0.8 or 2.0 µg Cd/ml as CdCl₂) and the other half Zn-amended nutrient solution (0.1, 1.0 or 2.5 µg Zn/ml as Zn SO₄) for three weeks. No treatment caused visible toxicity symptoms or a decrease in growth. However, there was evidence of an interaction between Zn and Cd affecting the accumulation of these elements at certain Zn/Cd treatment ratios in particular tissues.

VARIATION IN RECOVERY OF CERATOCYSTIS ULMI BY VARIATION IN SUBSTRATE AND TECHNIQUE. V. Spadafora, S. Blackington and R. J. Campana, Department of Botany and Plant Pathology, University of Maine, Orono, ME 04469.

Recovery of *Ceratocystis ulmi* from new elm xylem is simple by sterile technique, but uncertain from dying tissue. Comparative studies were made to isolate *C. ulmi* by septic or aseptic methods designed to induce synnema. More than 150 culture comparisons were made from 30 dead or dying trees. A total of 125 elm discs were used following inoculation with contaminating microflora, or water. Half of each group was inoculated, or not, with elm extract solution. Wood from 25 roots was shredded and rinsed to remove propagules for aseptic culture, or was incubated in septic culture with elm extract. Contamination reduced recovery of *C. ulmi* by 300%. Elm extract in contaminated cultures increased recovery by 200%. Recovery of *C. ulmi* from root samples in septic culture was greater by 700%, than in aseptic cultures. The data show that recovery of *C. ulmi* is often possible only with varied techniques.

INCIDENCE OF STEM CANKER ON BLUEBERRY IN NEW JERSEY. A.W. Stretch, USDA, SEA, AR, Rutgers Blueberry & Cranberry Research Center, Chatsworth, New Jersey 08019.

In 1980 highbush blueberries were inspected for stem canker caused by *Botryosphaeria corticis* in 4 random samples of 25 plants each in 28 fields on 17 different farms throughout the major blueberry producing areas in Atlantic and Burlington counties in New Jersey. Of 2800 plants inspected, 1340 were infected. This is 48% infection compared to 0.002% in 1951. This disease has caused extensive economic loss in North Carolina where resistant cultivars have proven to be the only economic control measure. At present there are few resistant cultivars adaptable to New Jersey growing conditions.

EFFECTS OF ROOT WOUNDING ON FUSARIUM ROSEUM DEVELOPMENT IN RED CLOVER. J. C. Stutz and K. T. Leath, Dept. of Plant Pathology The Pennsylvania State University and U. S. Regional Pasture Research Laboratory, USDA-SEA-AR, University Park, PA 16802

Penetration and colonization of roots and appearance of rot symptoms were observed in wounded and intact roots inoculated with three isolates of *Fusarium roseum* 'Acuminatum'. Although penetration and colonization by all isolates occurred sooner in wounded roots, wounding was not required by any isolate for penetration and initial colonization. One isolate penetrated into the cortex, proliferated through the cortex via intercellular runner hyphae, and caused necrosis within four days after inoculation; this sequence was not dependent on wounding. The other two isolates developed in this manner only when roots were wounded at inoculation. In intact roots, the later isolates penetrated epidermal cells and formed enlarged, swollen hyphae, in the root cortex. Runner hyphae did not form and necrosis was not observed at six days after inoculation. Thus while wounding accelerated the penetration of roots by all isolates, it also altered the host-pathogen interaction following infection.

PROTECTIVE AND AFTER-INFECTION ACTIVITY OF STEROL INHIBITORS AGAINST *MONILINIA FRUCTICOLA*. Michael Szkolnik, N.Y. State Agricultural Experiment Station, Geneva, N.Y. 14456.

Protection against brown rot blossom blight (*Monilinia fructicola*) was excellent with a bloom spray to sour cherry in the greenhouse with sterol inhibitors CGA 64251 and prochloraz (BFN 8206), and with benomyl and vinclozolin (Ronilan). An after-infection spray with CGA 64251, prochloraz, triadimefon (Bayleton), and triforine (CME 74770) 18 or 24 hr after inoc. gave excellent blight control as did iprodione (Rovral). Control was good with benomyl, and weak with dichlone (Quintar). Protection of sweet cherry fruit against brown rot with a 30-second postharvest dip was excellent with CGA 64251, prochloraz, fenarimol (EL 222), triforine, and biloxazol (Baycor), and fair with triadimefon. Control was excellent with vinclozolin and glyodin and fair with captan, iprodione, and benomyl. Fruit dip for 30 seconds 24 hr after inoc. gave excellent after-infection control with CGA 64251, prochloraz, fenarimol, and triforine; good with biloxazol; and fair with triadimefon, benomyl, iprodione, and glyodin.

EFFECT OF LEAF WETNESS DURATION AND TEMPERATURE ON INFECTION OF ONION LEAVES BY *BOTRYTIS SQUAMOSA*. M.R. Tanner and J.C. Sutton, Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada, N1G 2W1.

Onions were inoculated with conidia (10^4 /ml water) of *B. squamosa* and placed in moist chambers at 9, 12, 15, 18, 21 or 24 C. Leaf wetness was maintained for 6, 9, 12, 15, 18 or 24 h. Lesions/cm² of leaf and leaf dieback were measured at 48 h and 7 days. No lesions developed after 6 or 9 h wetness. Lesions appeared after 12-24 h wetness at temperatures ≥ 12 C, and increased in number with increased wetness duration. Lesions were most frequent after 24 h wetness at 18 C. Leaf dieback in the various treatments usually did not differ significantly from that in checks. Preinoculation leaf wetness periods of 24, 1 or 0 h had no significant effect on lesions numbers or dieback.

PINE WILT ASSOCIATED WITH *LEPTOGRAPHIUM* SP.-BLACK TURPENTINE BEETLE COMPLEX IN JAPANESE BLACK AND SCOTS PINE. T. A. Tattar, R. A. Rohde, R. Mankowsky, and H. D. Philbrik, Depts. of Plant Pathology and Entomology, Univ. of Mass., Amherst, 01003 and General Tree Service, E. Falmouth, MA.

Sudden browning of foliage over most of the crown, followed in rapid succession by needle droop, defoliation, and death of Japanese black pines (*Pinus thunbergii*) and Scots pines (*P. sylvestris*) has been observed on Cape Cod for several years. Resinosis from egg galleries of black turpentine beetles in the lower stem, root buttress, and on the tap root 30 to 60 cm below the soil line has been associated with these symptoms, as well as xylem discoloration (blue stain) throughout the mainstem and into the crown. *Leptographium* sp. has been isolated consistently from the discolored xylem. Pitch pines (*P. rigida*), attacked by the black turpentine beetles, rarely display symptoms. Similar vascular wilt symptoms occur on loblolly pine associated with blue stain fungi (Basham, 1960, *Phytopath.* 60: 750-754). The pinewood nematode (*Bursaphelenchus lignicolus*) was not isolated from any affected trees.

FLUCTUATIONS IN POTATO VIRUS M (PVM) TITER DURING THE GROWTH CYCLE OF THE POTATO PLANT. S. M. Tavantzis and M. Spear, Department of Botany and Plant Pathology, University of Maine, Orono, ME 04469

The enzyme-linked immunosorbent assay (ELISA) was developed for

the detection of potato virus M (PVM), a carlavirus that often induces no visible symptoms and occurs at low concentrations in infected potato plants. In young plants, prior to flowering, PVM titer was relatively low (0.77 A₄₀₅ units) in the basal leaves and barely detectable in the top leaves (0.09 A₄₀₅ units). With extracts from healthy plants A₄₀₅ was 0.02. In subsequent plant growth stages, however, PVM titer was higher in rapidly growing tubers (1.57 A₄₀₅ units) than in other plant parts. In mature plants, 2 weeks prior to harvesting, top leaves contained more virus (0.34 A₄₀₅ units) than middle (0.24 A₄₀₅ units) or basal leaves (0.15 A₄₀₅ units). Again, PVM titer was highest (>2 A₄₀₅ units) in growing tubers. Mature tubers, however, contained much less virus (0.71 A₄₀₅ units) than the rapidly growing tubers. Plant part and growth stage greatly influence detectability of PVM.

EFFECT OF SIMULATED ACIDIC RAIN AND PHOTOCHEMICAL OXIDANT ON SEED DEVELOPMENT IN SOYBEAN. John Troiano, Luke Colavito, Larry Heller, and Del McCune. Boyce Thompson Institute at Cornell Univ., Ithaca, NY 14853.

Two cultivars of soybean [*Glycine max* (Merr.) cv 'Williams and Beeson'] were exposed to acidic rain and photochemical oxidant in a 3x2 factorial design: simulated rain at pH 4.0, pH 3.4, and pH 2.8 applied in covered field-chambers receiving either filtered or unfiltered air. After harvest plants were air dried to retain seed viability. In Williams, the percent germination of seed at pH 4.0 was greater than at pH 2.8 and a maximum occurred at pH 3.4. Also at each level of acidity seed from plants grown in filtered air had a greater percent germination than from unfiltered air. Among treatments, germination was negatively correlated with occurrence of green seed but not correlated with seed size. In Beeson, there was no consistent treatment effect on germination nor was there a correlation of germination with green seed or seed size. These results indicate that pollutant stress may alter the developmental relationships between vegetative and reproductive organs.

INFLUENCE OF THATCH ACCUMULATION ON DISEASE INCIDENCE AND FUNGICIDAL EFFECTIVENESS IN KENTUCKY BLUEGRASS TURF. Richard E. Wagner and Philip M. Halisky, Department of Plant Pathology,

A study was conducted on four-year old Merion Kentucky Bluegrass turf to evaluate the relationship between fungicide applications, thatch accumulation and dollar spot (*Sclerotinia homoeocarpa*) incidence. The treatments used were a systemic (benomyl) fungicide, a contact (iprodione) fungicide and a non-treated control. One half of the plots were dethatched with a power rake over a two-year period. In 1979, the average dollar spot severity in dethatched turf was: benomyl 4%, iprodione 4% and control 55.4%. In a non-dethatched turf the corresponding disease incidence was 20% 21%, and 57%, respectively. In 1980 the average dollar spot severity in dethatched turf was: benomyl 15%, iprodione 7%, and control 9%. In non-dethatched the corresponding disease incidence was 68%, 35%, and 46%, respectively. These results indicate that thatch development in turf is conducive to dollar spot and may inhibit chemical control.

ARMILLARIA MELLEAE COLONIZES ROOTS OF OAK INJECTED WITH ETHANOL Philip M. Wargo, USDA Forest Service, Hamden, Ct 06514

Ethanol (ETOH), which can be found in roots under anaerobic conditions, stimulates the growth *in vitro* of *Armillaria melleae* (AM). To determine if ETOH promotes colonization *in vivo*, roots of black and white oaks, 12 each concentration, were injected with 0, 5, 20, or 50% ETOH at .5 l/in diam. Trees were injected via 3 roots in mid-June 79. Half were examined in Sept. '79 and half in Aug. '80. None (0/24) of the 0 or 5% trees were infected by Sept. but most (19/24) of the 20 and 50% trees were extensively colonized by AM from naturally occurring rhizomorphs by Aug. '80 a few (3/12) 0 and 5% white oaks were colonized but it was limited to dead wood beneath callous tissues. All 20 and 50% trees were colonized by AM but the fungus on most trees was confined to tissues killed by ETOH when injected in '79. Other studies in summer '80 showed that tissues died within 2 days after injection but it was 6 to 8 weeks before AM colonized the tissues. Once AM colonized these tissues the fungus was effectively walled off in both bark and wood by vigorous trees.

IN VITRO RESPONSE TO GALLIC ACID OF AGGRESSIVE AND NONAGGRESSIVE "ISOLATES" OF *ARMILLARIA MELLEAE*. Philip M. Wargo, USDA Forest Service, Hamden, Ct. 06514

Gallic acid (GA) can stimulate or inhibit growth of *Armillaria melleae* depending on the isolate (ISOL) and whether ethanol

(EtOH) is or is not present. To determine whether there is a relationship between GA metabolism and pathogenicity, ISOL that were tested for pathogenicity on pine (C.G. Shaw, PDR 61, 1977) were grown on agar medium with 0.5% GA with or without EtOH. All highly pathogenic ISOL were completely inhibited by GA with and without EtOH; some ISOL were killed. Less pathogenic ISOL - western hardwood ISOL - were inhibited by GA without EtOH but not by GA with EtOH. They responded similarly to eastern hardwood ISOL that become pathogenic only after stress has altered the tree. This striking difference in response to GA between aggressive ISOL that may act as primary pathogens on pine and less aggressive ISOL suggests that growth on GA may be used to distinguish aggressive from nonaggressive ISOL.

HISTOLOGICAL CHANGES OF BACTEROIDAL TISSUES IN NODULES OF PEANUTS INFECTED BY PEANUT MOTTLE VIRUS. S. Wongkaew and J.F. Peterson, Plant Science Dept., Macdonald Campus of McGill University, Ste. Anne de Bellevue, Quebec, H9X 1C0.

Nodules from a peanut (*Arachis hypogaea* L.) cultivar mechanically inoculated with peanut mottle virus (PMV) differed histologically from those of non-infected plants. Bacteroidal tissues of PMV-infected contained vesicles, amorphous bodies within vacuoles, smaller or non-transformed rhizobia, less membrane integrity, and more malformed bacteroidal cells than corresponding tissues of non-infected nodules. Such abnormal cells were distributed randomly within the infected tissue, and were present in most of the infected nodules of any age. Similar abnormalities also occurred in the disintegrating old nodules of control plants, but were distributed more uniformly. The effects of PMV infection were generally similar in nodular tissues infected by effective or non-effective rhizobial strains, but the latter showed small necrotic areas as well. The histological changes observed may be the cause of reduced N_2 -fixation activity of PMV-infected plants.

SPORE RELEASE IN *NAEMACYCLUS MINOR*. L. Zang and W. Merrill. Department of Plant Pathology, The Pennsylvania State University, University Park, PA 16802

Rotorod spore traps were used to assess release of ascospores of *N. minor* in an infected *Pinus sylvestris* plantation in Centre Co., PA. Sampling began on 3 April 1980. Spore release had begun before the onset of sampling and peaked between 14 April and 10 May. It declined after 7 June and continued at low levels through September. Some release accompanied dew, but significant release occurred only after measurable rain. Peak release occurred 4-6 hours after onset of rain and declined rapidly thereafter. During prolonged rain periods, secondary peaks occurred. Spores were caught over a temperature range of 1.7 C to 26.7 C. Mean air temperature for the 8 hours prior to the 6 highest spore catches ranged between 6 C and 20 C. Spores were released from the ascus singularly or in groups of up to eight.

DOUBLE STRANDED RNAs IN TOBACCO MOSAIC VIRUS-INFECTED TOBACCO TISSUE. Aaron Zelcer, Karen Weaber, Ervin Balažs and Milton Zaitlin, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

Three species of TMV-related double-stranded RNA have been found in infected tissues, in addition to the known replicative form of 4×10^6 MW. These RNAs, designated ds-1, ds-2 and ds-3 have apparent molecular weights of 2.25×10^6 , 1.1×10^6 and 0.32×10^6 , respectively. RNA hybridization to both ^{125}I -TMV-RNA and a portion representing the one-sixth of TMV RNA containing its 3'-end showed that each of the ds RNAs contains the 5' end of the minus strand of TMV RNA.